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TM 3-305

WAR DEPARTMENT

U. S. Dept. of Army

TECHNICAL MANUAL

USE OF SMOKES AND LACRIMATORS IN TRAINING

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TECHNICAL MANUAL

USE OF SMOKES AND LACRIMATORS IN TRAINING

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON 25, D. C., 17 November 1943.

TM 3-305, 5 July 1940, is changed as follows:

20.1. (Added.) **Exercise No. 8—Use of mustard (H) in training.**—*a. Purpose of training exercises.*—(1) Field exercises with mustard are intended to demonstrate that—

(*a*) Presence of persistent gas does not necessarily prevent troops from advancing through gassed areas.

(*b*) Actual experience in advancing through training areas contaminated by toxic chemicals inspires confidence in the soldier's ability to meet gas situations under combat conditions.

(2) In order to attain these purposes, it may sometimes be necessary to utilize terrain not tactically suited for the type of action involved. Whenever inconsistency may appear between technical and tactical training doctrines, appropriate explanations are to be made by instructors.

b. Conduct of training exercise.—The following exercise is recommended. It may, on advice of chemical officers, be amplified or varied to simulate tactical situations more appropriate to the troops being trained.

(1) One hour before the exercise, explode a group of five mustard-filled land mines in an area approximately 130 yards wide by 125 yards long where the ground is bare or the grass is very short. (See fig. 13.) Have gas noncommissioned officers reconnoiter the gassed area, mark off the ground actually contaminated (chloride of lime may be used to indicate the limits of each burst) and post gas warning signs.

(2) After the marking of the gassed areas has been verified by the chemical officer, move up the detachment being trained (one infantry platoon or unit of similar size) and advance the troops so as to move in squad columns between the first two gassed areas. (See fig. 13.) As each squad approaches close enough to unmistakably distinguish the odor of mustard, have it pause for a period up to 1 minute. Individuals should then don and carefully adjust gas masks, unit gas noncommissioned officers assisting in checking of masks.

(3) Squads may then advance in single file or in skirmish line directly across the remaining contaminated area, picking their way and avoiding treading in pools of liquid agent. They should be in-

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e. Storage and handling of mustard.—The storage and handling of mustard will be in accordance with TM 3–250. Particular reference is made to paragraphs 38*b* and *c* and 41*l*.

[A. G. 300.7 (26 Apr 43).] (C 1, 17 Nov. 43.)*

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1943

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TECHNICAL MANUAL

USE OF SMOKES AND LACRIMATORS IN TRAINING

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON 25, D. C., 10 February 1944.

TM 3–305, 5 July 1940, is changed as follows:

12.1. Use of chlorine and mustard gas in training (Added).—When chlorine and mustard gas are used in training, the following rules will be observed:

a. The use of chlorine and mustard gas will in all instances be under the personal and direct supervision of a commissioned officer of the Chemical Warfare Service. This limitation does not apply to the use of instructional gas-identification sets or of detonation gas-identification sets.

b. Chlorine in all instances will be released only in the gas chamber.

c. The use of mustard gas, generally to contaminate matériel, equipment, and terrain for purposes of training personnel in methods of decontamination and the use of decontamination materials and equipment, will be the determination and responsibility of the commander.

12.2. Use of CNB from aircraft (Added).—Large drops of CNB sprayed on personnel from airplanes at low levels may cause permanent injury to the unprotected eyes and severe irritation of the skin, especially in hot weather. Consequently, in all instances where this liquid is sprayed from airplanes for the purpose of training or demonstration, the following precautions will be taken:

a. CNB will not be released when it might cause discomfort or inconvenience to persons not involved in the training, or where the spray will fall on highways that have not been closed to traffic.

b. Troops should be cautioned that it is dangerous to look up when an airplane spraying CNB is immediately overhead or has passed over, or just upwind of them, unless the eyes are protected.

c. Troops contaminated with CNB should remove their clothing as soon as practicable and take a bath, using a 3- to 5-percent solution of sodium bicarbonate, followed by soap. The eyes, if contam-

*This change supersedes Training Circular No. 66, War Department, 1942.

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inated, should be irrigated with a 2- to 3-percent solution of sodium bicarbonate.

[A. G. 300.7 (5 Jul 40).] (10 Feb 44.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1944

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TECHNICAL MANUAL
No. 3–305

WAR DEPARTMENT,
WASHINGTON, *July 5, 1940.*

USE OF SMOKES AND LACRIMATORS IN TRAINING

**Prepared under direction of the
Chief of the Chemical Warfare Service**

Paragraphs
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CHAPTER 1

MUNITIONS AND TECHNIQUE

Paragraphs
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II. Training agents 2–5
III. Training munitions 6–11

SECTION I

GENERAL

Paragraph
General 1

1. General.—*a.* Military training of both individuals and organizations has, as its final objective, preparation for meeting battlefield conditions. The nearer the approach to these actual conditions, the more effective is the training. However, the safety of individuals and property places limitations on the extent to which battle conditions can be simulated. A soldier may be instructed in the taking of cover as protection against hostile high explosive or small-arms fire, but he will not be fully trained in doing so until he has been subjected to such fire. However, this is not feasible and much must be left to the imagination.

b. In chemical warfare training, the extent to which battle conditions may be approached is probably greater than in any other form of warfare. It is true that, like high explosive and bullets, lethal agents such as mustard gas cannot be used for training purposes; but it is also true that, unlike high explosive and bullets, other chemical agents may be used to represent these lethal agents. The effects of these substitute agents are confined to temporary discomfort and inconvenience, yet are sufficient to give a feeling of realism

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that results in far better training than could be attained if the effects were left entirely to imagination.

c. In some cases, the type of chemical ammunition used in warfare is such as to preclude its use for training purposes. As in the case of chemical agents, certain substitutes have been developed which may be employed in training. This combination of suitable training agents and munitions affords a method for conducting chemical warfare exercises that prove highly realistic yet entirely safe for instructional purposes.

d. It should be understood that, except in the employment of training munitions, the training considered herein does not include instruction in the firing of chemicals. Such training is conducted along the same general lines as followed in the case of high explosive projectiles or of small-arms ammunition.

Section II

TRAINING AGENTS

	Paragraph
Types	2
Screening smokes	3
Lacrimators	4
Restrictions on use	5

2. Types.—The chemical agents that lend themselves to use in training are the screening smokes and lacrimators. These agents are warfare agents as well as training agents. They may therefore be used either to illustrate their own tactical employment or to represent highly toxic chemicals. Information on the characteristics of the various agents will be found in FM 21–40.

3. Screening smokes.—*a. Agents.*—(1) The agents used for the producing of screening smokes fall in three classes as follows:

(*a*) Agents for use with explosive munitions.
(*b*) Agents for use with equipment designed for dispersing liquids.
(*c*) Agents for use with burning type munitions.

(2) One standard agent is provided for each class as follows:

(*a*) Explosive munitions, white phosphorus (WP).
(*b*) Liquid dispersion, sulfur trioxide—chlorsulfonic acid (FS).
(*c*) Burning munitions, hexachlorethane (HC).

b. White phosphorus (WP).—This agent is an incendiary as well as a smoke agent. Its incendiary action and the fact that it is used in explosive munitions prevent its employment in the type of training considered herein. One of the other smoke agents must be used to represent fire with white phosphorus.

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c. Sulfur trioxide—chlorsulfonic acid (FS).—This agent has an acid action which necessitates certain restrictions on its use. It must not be used where the liquid agent will strike personnel, matériel, buildings, etc. The danger is greatest when sprayed from aircraft. Regulations require that airplanes spraying FS will fly at an altitude of 300 feet or less, and that the distance from the line of flight to the nearest injurable object will be at least twelve times the altitude of the plane. A cloud released under these conditions will cause a stinging sensation on the skin. This effect soon passes. FS should only be used on military reservations and then on areas where all activities can be controlled.

d. Hexachlorethane (HC).—This agent is harmless and personnel and matériel can be exposed to high concentrations without injury. Properly used, it may be employed to represent any of the smoke agents and is the most valuable for training purposes.

4. Lacrimators.—The standard lacrimator for training purposes is chloracetophenone (CN) used in burning type munitions or in solution.

a. Chloracetophenone (CN) burning mixture.—This agent, formerly supplied in candle form, is now found in grenades and capsules. The cloud generated causes a flow of tears, the severity of which depends upon the concentration. Heavy concentrations will cause a temporary skin irritation. Both effects pass off quickly after the individual ceases to be exposed. In the open air, the gas dissipates rapidly after the munition stops burning.

b. Chloracetophenone in solution (CNB).—This consists of CN dissolved in equal parts of benzene and carbon tetrachloride. CNB should not be confused with CNS, a far stronger solution intended for tactical use. The action of CNB is to cause a flow of tears. As in the case of the burning mixture, the severity of the flow of tears depends upon the concentration and the effect soon passes after exposure ceases. CNB is used with equipment requiring a liquid agent. Its persistency will vary from one to several hours depending upon the method of release and the weather conditions.

5. Restrictions on use.—In addition to any restriction applicable to an individual agent, the following general restrictions should be observed:

a. Clouds of either smoke or lacrimators should not be released where they will cross highways unless such highways are closed to traffic.

b. Lacrimators should not be released when they will cause discomfort or inconvenience to persons not involved in the training.

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c. When smoke is used, precautions should be taken to prevent false alarms of fire.

SECTION III
TRAINING MUNITIONS

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CN capsule	10
Smoke pot	11

6. General.—Training munitions are, in general, standard equipment or ammunition. Some are designed primarily for training purposes. Others are designed for use in war but may be adapted to training requirements. Because of safety requirements, explosive type munitions cannot be used in training. Equipment and munitions found suitable are—

a. Liquid dispersion apparatus.

(1) Portable cylinders.
(2) Airplane tanks.

b. Burning type munitions.

(1) Hand grenades.
(2) CN capsules.
(3) Smoke pots.

7. Portable cylinder, MII.—Designed for the release of lethal agents, this weapon may be used for the release of FS or CNB in training. The filled cylinder which weighs about 55 pounds contains a little over 30 pounds of chemical agent. Valves for both hand and electrical release are available. In training exercises, cylinders are usually discharged by hand. One man can release up to four cylinders without undue delay. The period of discharge is approximately 2 minutes. CO_2 must be added to the agent to provide the needed pressure for expelling it from the cylinder. Charged with FS, the cylinder may be used to illustrate airplane smoke blankets or clouds of lethal agents released from cylinders. Charged with CNB, it may be used to represent various forms of lethal gas attack.

8. Airplane tank.—This tank, designed for the dispersion of smoke and persistent agents, is part of the equipment of light bombardment aviation. For training purposes, subject to the restrictions in paragraph 3*c*, airplane tanks charged with FS may be used to demonstrate and train in the use of smoke by aircraft in the same general way as employed in war. When tanks are filled with CNB,

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aircraft can be employed for training in protection against hostile aerial attack with lethal agents.

9. Hand grenade.—This grenade, described as grenade, hand, gas, irritant, CN, M7, is a fast burning type munition with CN filling. It is the standard munition for releasing CN in training and has replaced the CN candle formerly used. The grenade is cylindrical in shape and weighs approximately 1 pound, including the weight of the filling which is 10 ounces. Fired with a standard type grenade mechanism, it burns from 25 to 40 seconds. The grenade does not lend itself to any method of use except that of throwing by hand, consequently a detail of men is required. Its use in training is to represent attack with warfare agents dispersed by cylinders, shells, or bombs.

10. CN capsule.—The CN capsule is a small capsule filled with solid CN. It melts when heat is applied to it, as by a lighted candle, giving off a small cloud of gas. Its only use is that of providing gas concentrations for gas chamber work. It is unsuitable for use in the open.

11. Smoke pot.—*a. Description and use.*—The smoke pot, HC, MI, is classed as a training munition but might have limited use in battle for generating smoke clouds within friendly lines. For training purposes, it has a wider use than any of the other chemical munitions. The pot is a cylindrical can 7¾ inches high and 5$^{5}/_{16}$ inches in diameter, filled with 12.5 pounds of HC smoke mixture. The can has a recessed top in the center of which is placed a match head to be ignited by a scratch block. The match head may also be ignited by electric squib or it may be removed and the squib inserted in place of the match head. A cover with carrying handle is fitted over the top and held in place by tin strips which are easily removed. The smoke pot, filled, weighs 14.3 pounds. The average burning time is 6½ minutes. About 20 seconds elapse after ignition before the pot begins release of smoke in full volume.

b. Technique of operation.—(1) *Location.*—Smoke pots are placed so as to show their own tactical use or to represent the use of other types of munitions. The area or line on which release takes place should, as a rule, be that on which battle munitions would be used. This is subject to such modification as required to insure that the area to be screened is properly covered, and for economy of munitions. Figure 1 illustrates this modification.

(2) *Time factor.*—Having determined the time at which the screen is desired, pots should be fired sufficiently in advance of this time for the screen to form. Including the 20-second delay for the pot to reach full volume, a period of 45 seconds to 1 minute will ordinarily be

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required. Screens will often be required for periods longer than the 6½-minute burning time of the first pots ignited. Additional 6½-minute periods may be obtained by placing the pots in series, the top of the second series being placed against the bottom of the first series, and the top of the third series being placed against the bottom of the second series. Heat generated during burning of one series will ignite the match heads of the next series. (See fig. 5 ⑤

(3) *Manual discharge of smoke pots.*—Smoke pots are placed in position and covers removed prior to the time set for the exercise.

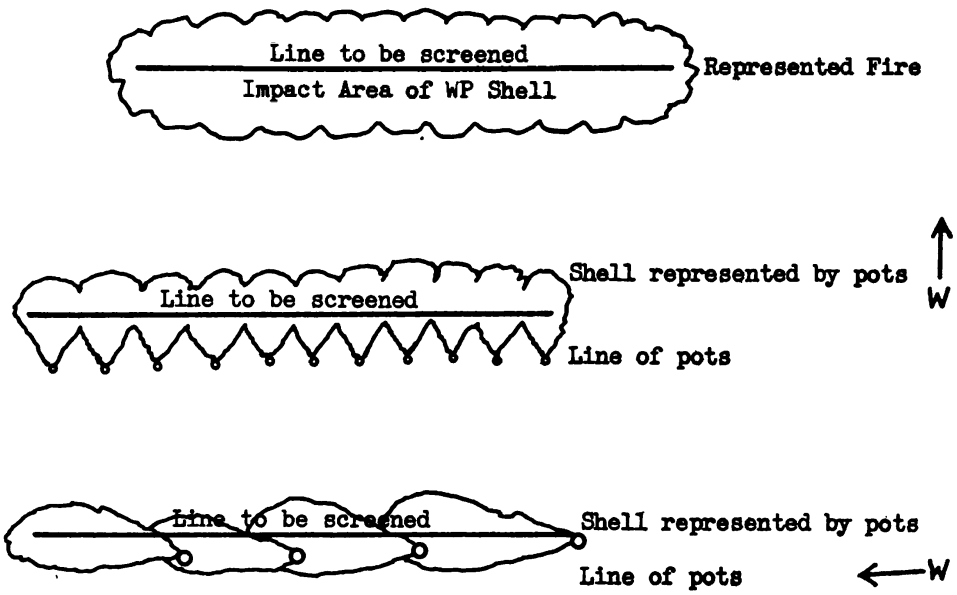

FIGURE 1.—HC smoke pots employed to represent WP shell fire.

One man can fire up to four pots by the scratcher block method. The firing detail must therefore be about one-fourth the number of pots to be fired. This method has the disadvantages of requiring a number of men and of having men running over the area supposedly near an enemy and under fire.

(4) *Electrical discharge of smoke pots.*—Electrical discharge of smoke pots has advantages in that the installation can be made in advance of the exercise, but one man is required for the discharge of the pots at time of the exercise, and the absence of a firing detail results in a more realistic exercise. The equipment and method for electrical discharge is as follows:

(*a*) *Equipment.*

1. Wire.—Firing, double lead No. 14. Telephone wire, type W40 may be used.

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2. *Discharger.*—Exploder, magneto, 30 cap, engineers; blasting machine; or one 6-volt storage battery for each 500 feet of wire; or six dry cells for each 500 feet of wire.
3. *Squibs.*—One for each firing point. Expendable on certificate (AR 775–10).
4. *Adhesive tape.*—Tire or electrical.

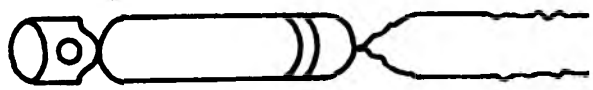

FIGURE 2.—Squib.

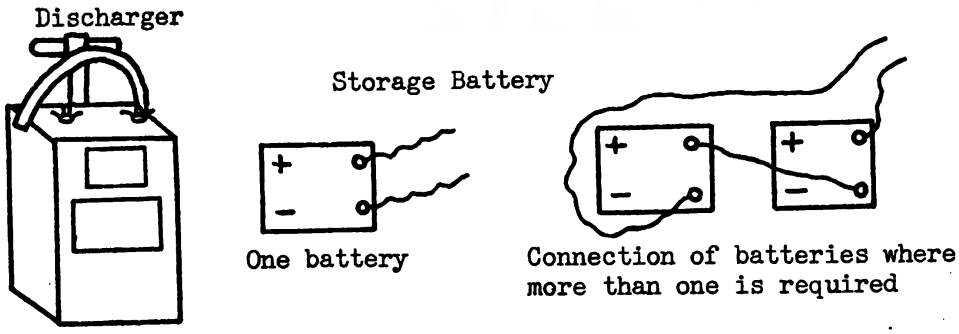

FIGURE 3.—Blasting machine, commercial type, or exploder 30 cap, engineers, or 6-volt storage battery.

NOTE.—When using dry cells or one or more storage batteries for firing smoke pots, one wire is not connected to a post of the battery. After all connections have been made between the squibs and the battery, the smoke pots are fired by touching the wire that was left disconnected to the post of the battery.

(*b*) *Method of attaching squib.*

1. When using the method in which the squib is held in place by adhesive tape, care must be taken that the flame of the squib will strike the match head and that the tape will securely hold the squib in that position.
2. When inserting the squib in place of the match head, the latter may be removed by pulling it out or it may be pushed down into the smoke pot. The squib should be held in place by tape. This method gives excellent results, but should the exercise be called off, the contents of the smoke pot are left exposed and they may be fired later only by the electrical ignition method.
3. The sides of the lids of the smoke pots should be bent in to allow for passage of wires and the lids lightly replaced if there is a probability of moisture entering before firing. The lids must not be forced into position as damage to the squib or wires might result.

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(*c*) *Method of wiring.*

1. See that the wire is clean at all connections, that the squib wires are firmly wrapped, and that the open connections do not touch the ground. If the latter is carefully observed, it will not be necessary to tape the joints.

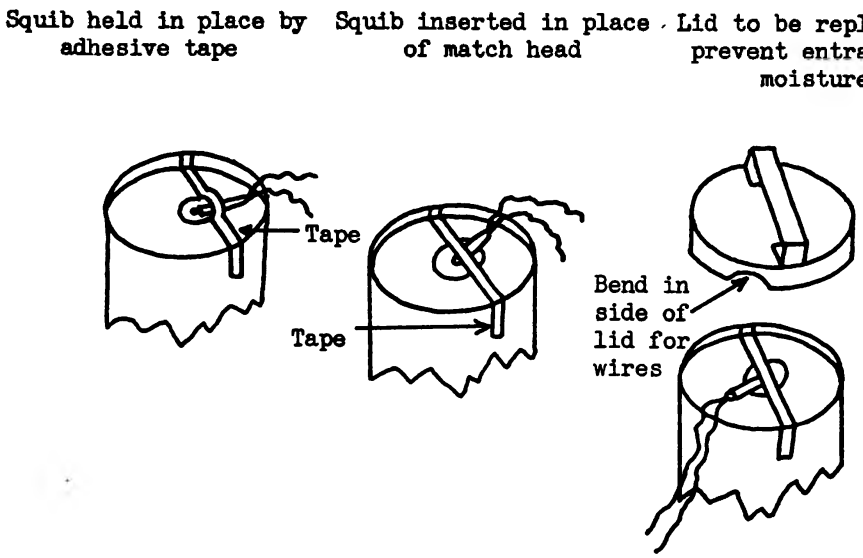

FIGURE 4.—Method of attaching squib.

2. In the battery or parallel hook-up, squib wire connections to firing wire should be spaced at sufficient distance to prevent a short circuit.

3. The first series is attached as shown in figure 5 ⑧.

4. The lids of the smoke pots in the second and succeeding series are removed. Match heads are left intact.

5. The tops of the smoke pots in the second series are placed firmly against the bottoms of the pots of the first series, those in series three against series two, etc.

6. A shallow trench will hold the smoke pots in position.

7. When the first series has burned down to the bottom, the heat will ignite the next series.

(*d*) *Length of burning time.*—Smoke pots burn from 5 to 8 minutes. The length of burning time depends somewhat upon the position of the smoke pot on the ground; that is, whether it is standing on end or lying on its side. Laying the smoke pot on its side tends to speed up the rate of burning, hence shortens the total time of burning. A series should be installed for each 6 minutes of time it is desired to maintain the smoke.

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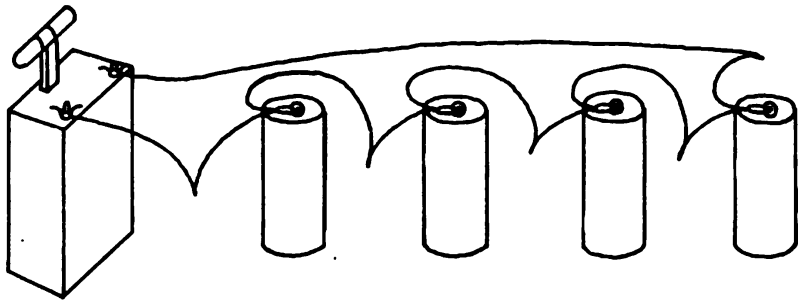
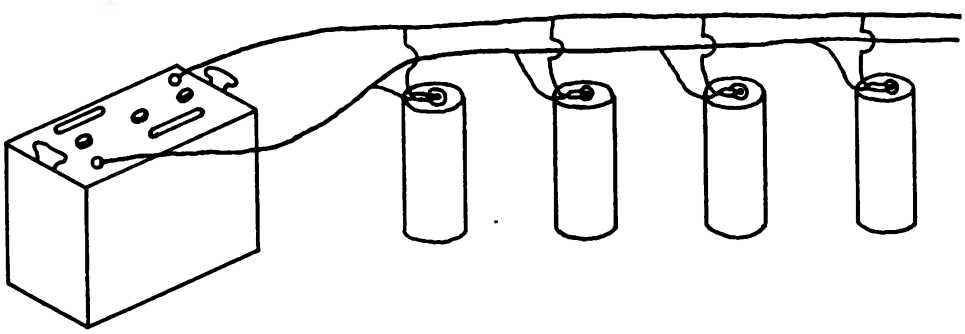
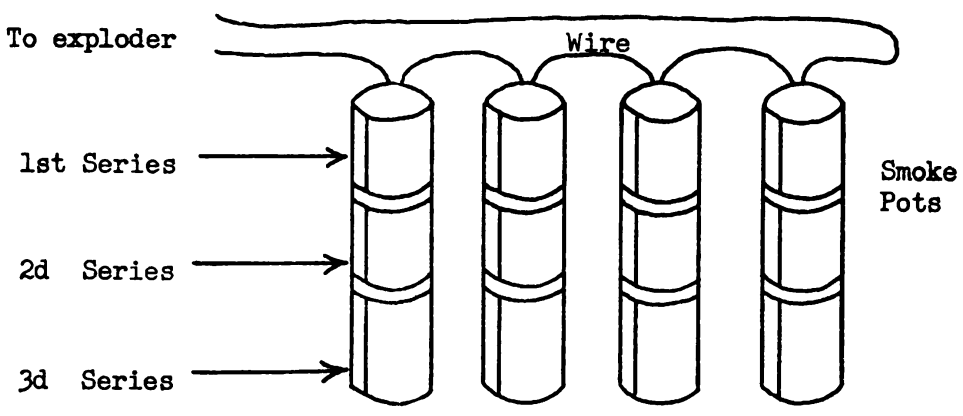


① Exploder (Series)

BATTERY (PARALLEL)



② Battery (Parallel)



③

FIGURE 5.—Method of wiring pots for electrical ignition.

NOTE.—Not more than 20 squibs should be fired by an exploder at one time.

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CHAPTER 2

EMPLOYMENT IN EXERCISES

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III. Gas chamber 21

SECTION I

GENERAL RULES

Paragraph
General rules 12

12. General rules.—In the application of chemical agents to training, the following rules should be observed:

a. Each exercise should have as an objective the teaching of one or more specific lessons in chemical warfare protection, such as the protective use of smoke, measures to be adopted in case of hostile nonpersistent gas attack, or selection and occupation of alternate positions to avoid areas contaminated by persistent gas.

b. The types of chemical warfare operations illustrated in any given exercise should not be more than three. A greater number is confusing and results in none of the training making an impression.

c. The exercise should be simple in execution. A complicated plan of operation is not only difficult to execute but is also confusing to those being trained.

d. The exercise must be logical. Improbable situations result in an adverse reaction on the part of those participating.

e. Troops not equipped to protect themselves against tear gas should not be subjected to it.

f. Where possible, the chemical warfare situation should be incorporated in exercises prepared for other tactical instruction. Such application demonstrates that chemical agents may be encountered in any type of action and are not confined to special situations.

g. Where chemical warfare is applied to an exercise drawn for another purpose, care must be taken that it does not defeat the original purpose of the exercise unless agreed to by those responsible for the exercise.

h. A check list of points to be observed should be prepared for each exercise. The action on the part of those being trained, as shown by this check list, provides data on the status of training in chemical warfare protection.

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SECTION II

SUGGESTED EXERCISES

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Exercise No. 2—Smoke to cover an infantry attack	15
Exercise No. 3—Influence of smoke on artillery fire	16
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Exercise No. 6—Employment of gas in interdiction fire	19
Exercise No. 7—Employment of gas in harassing fire	20

13. General.—The exercises suggested herein serve as models in the use of smoke and lacrimators in training. These are suggested methods subject to modification to meet local conditions, such as type of organization being trained, size of organization, available munitions, and terrain and weather conditions. Subject to such modifications, it will be found that these exercises can be applied to a variety of situations.

14. Exercise No. 1—Influence of smoke on aimed rifle fire. (For use by all troops armed with the rifle.)—*a. Object.*—The object of this exercise is to illustrate the influence of blanketing smoke on aimed rifle fire.

b. Discussion.—(1) It may be taken as axiomatic that a man firing a rifle under conditions that prevent him from seeing his target will never be able to get as many hits upon that target as when his target is clearly visible. Nighttime and natural fog are examples of conditions that prevent clear vision of a target. The deliberate use of smoke for obscuring purposes closely approaches the conditions of a heavy fog, if not actual conditions of night, except that in using smoke, the smoke blanket is placed upon the target or upon the men firing and not usually upon both.

(2) It has been demonstrated upon many occasions that troops firing at targets that are covered by smoke may expect to get approximately 12 percent hits while if the firers themselves are blanketed by smoke they may expect to get approximately 3 percent hits even though their targets may be in the open. (See fig. 6 ① and ②.)

(3) The greatest advantage, therefore, will accrue when a blanketing smoke is placed upon the enemy for his firepower is reduced to approximately three hits in 100 while your own is reduced to approximately 12 hits in 100; or rather, the reduction will be in that proportion since such high percentages of hits may never be expected in actual combat. (See fig. 6 ③.)

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(4) A consideration of the objectives of the attack and the defense will reveal advantages and clear up some points in question. The defense primarily desires a clear field of fire and clearly outlined targets which, together with the advantages of their defensive positions, insure their maintenance of superiority in fire power. At the same time, the defending force commander desires all possible information in regard to the direction and progress of the attack in order that he may properly dispose his reserve. By placing smoke on the advancing troops, he will handicap himself in every particular. He will not only be obscuring the very targets which he desires to be most clear cut, but he will be cutting off his observation, leaving himself in the dark as to the direction and progress of the main effort. *The defending force commander should not use smoke in this situation.*

(5) On the other hand, the object of the attacking force is to defeat the enemy, to suffer a minimum of casualties and disorganization during his advance, and to maintain superiority of fire at least until the assault takes place. By placing smoke on the defending forces so that they must operate with no observation and no clear cut targets, or with their fire power reduced to about 3 percent of their expected hits, the attacking force will increase their relative fire power. *The attacking force will gain a great advantage by using smoke.* The principal object of this exercise is to demonstrate the extent of this advantage.

(*a*) If the smoke is placed between the two lines, it will be necessary for the advancing troops to proceed through their own smoke at least for a portion of their advance. This may lead to a partial loss of control and to disorganization which to a degree depends upon the state of training and discipline of the organization.

(*b*) It is evident that in an attack, the greatest benefit will accrue if the defending force is blanketed with smoke during the progress of the attack up to the point from which the attacking troops will launch their assault. At this time the smoke should be lifted.

(*c*) It is obvious that an effective smoke blanket should be built up just before the attacking force is within effective range of the defending rifle and machine-gun fire and should be maintained until the assault is made.

c. Details.—(1) This exercise is usually carried out on the rifle range or on the combat range. From 12 to 20 men should compose the firing line. In selecting men, it is desirable to have 50 percent good shots and 50 percent unqualified. This will give an idea as to the effect of smoke on both classes. The exercise should be preceded by the explanation. All other men should observe the firing and the

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results should be given to all as the phases are completed. A line of silhouette targets, one for each firer, is set up 300 yards from the firing point. After sighting in their pieces, the riflemen fire five shots in 1 minute. The officer in charge has a stop watch and gives the command to fire and cease firing. About 55 percent of the shots fired will hit the targets. A careful record is made of the number of hits on each target and the targets pasted.

(2) A smoke screen is then set up in front of the targets, completely obscuring them from the firers (fig. 6 ①). A line of smoke pots is placed about 100 yards in front of the targets or to the flank or rear of the targets depending upon wind conditions. These pots are wired for electrical discharge as described in paragraph 11*b*. (4). The battery or exploder will be placed at a point in rear of the riflemen or in the rifle pits. As soon as the screen is developed and the targets obscured, each rifleman fires five shots in 1 minute. About 12 percent of these shots will hit the target. The hits are again counted and the targets pasted.

(3) A smoke screen is now set up by pots placed so as to blanket the firers (fig. 6 ②). When the riflemen are blanketed, each rifleman upon command of the officer in charge fires five shots in 1 minute. About 3 percent of the shots fired will hit the target.

d. Remarks.—Figure 6 ③ combines the results given in figure 6 ① and ② and applies them to infantry combat. An enemy on the defensive occupies the ridge at A. Friendly infantry has jumped off from the line of departure at B and is advancing at C. One platoon of chemical mortars is located at D. This platoon is firing blanketing smoke on the enemy at A. The advancing infantry is firing under the conditions of figure 6 ①, that is, with smoke on the target. Under the conditions of the experiment, they should be making 12 percent hits. The enemy, on the other hand, is firing under the conditions of figure 6 ②. The smoke is located on them. Under the conditions of the experiment, they should be making 3 percent hits. The offensive fire is then about four times as effective as defensive fire.

e. Points to be noted.—(1) Blanketing smoke placed on other direct fire weapons has effects similar to its effects on small arms fire.

(2) Blanketing smoke placed on artillery observation posts will force unobserved artillery fire with its attendant inaccuracy.

(3) In some instances, due to protection given by blanketing smoke, it may be possible to reduce the rate of infantry fire during

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the advance. Also it may be possible to increase the rate of advance. The former should save ammunition; the latter should reduce casualties.

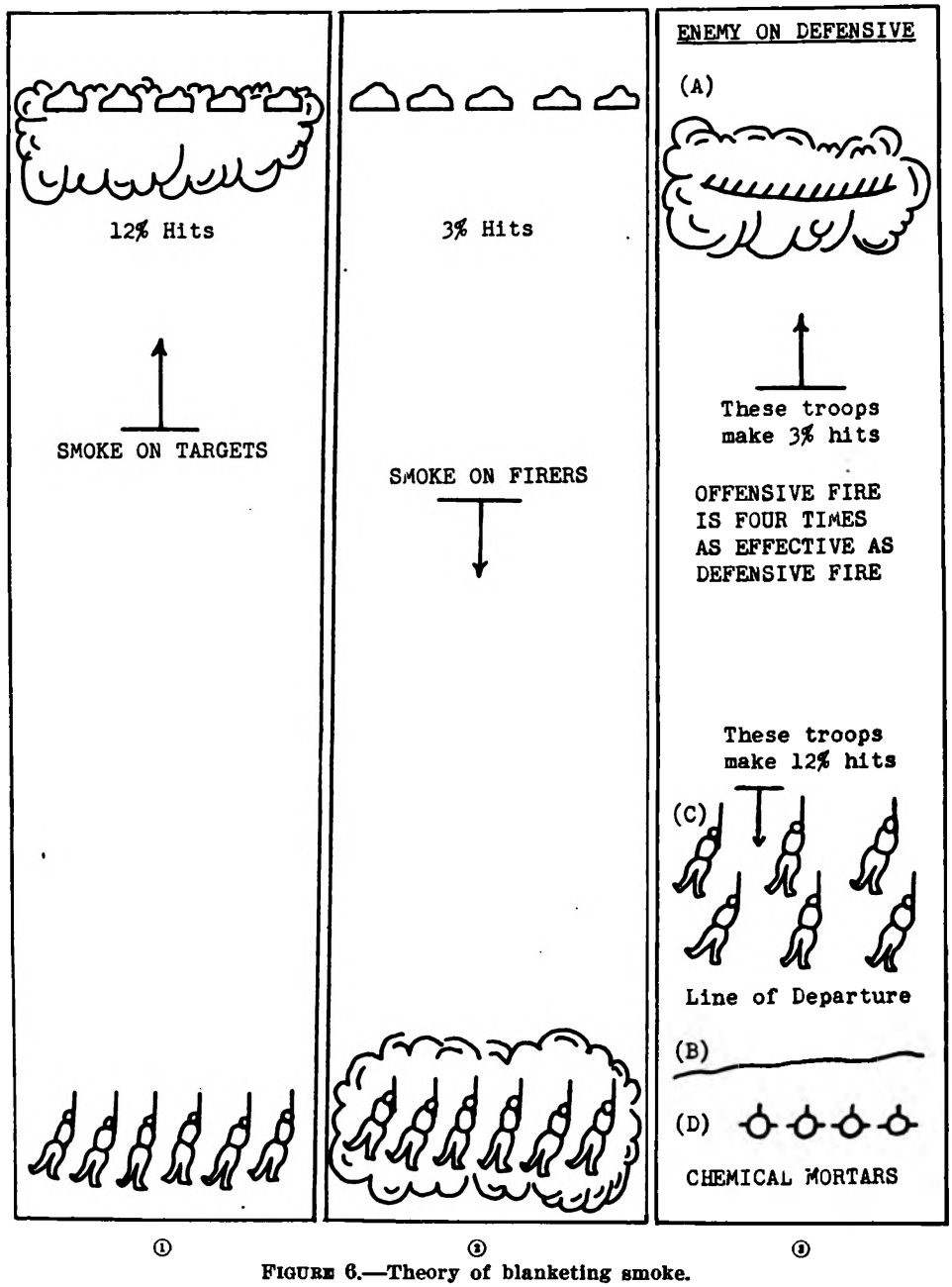

FIGURE 6.—Theory of blanketing smoke.

15. Exercise No. 2—Smoke to cover an infantry attack. (For use by Infantry, Corps of Engineers, or dismounted Cavalry.)—

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a. Object.—The object of this exercise is to illustrate the use of smoke to reduce the effectiveness of the defender's fire during an attack.

b. Discussion.—The screening of an attacking force in crossing open terrain is one of the most important uses of smoke. In tests of the effect of smoke on rifle fire, it has been found that the fire efficiency of the force using smoke is reduced to about 25 percent of that obtained without smoke. At the same time, the fire efficiency of the force placed in smoke is reduced to about 6 percent of that obtained without smoke. Assuming forces of equal fire efficiency without smoke, the use of smoke results in an advantage of four to one for the user. Smoke is employed on the portions of the enemy's line having good fields of fire. The smoke should be placed before the attacking force arrives in the zone of effective small-arms fire and should cease in time for the cloud to dissipate sufficiently to permit an unhampered assault. The use of smoke will permit a more rapid rate of advance on the part of the attacker. The 4.2-inch chemical mortar is the weapon best suited for the firing of smoke in this type of action. In time of war, the chemical agent used would be white phosphorus.

c. Details.—(1) This exercise is primarily for the training of infantry units. Preferably it should be included in a tactical exercise, but may be carried out for the sole purpose of training in attack under the cover of smoke. As small a force as a company may be employed, while it is possible to have a force as large as two battalions. One battalion is the unit that can be trained to the best advantage. Where two battalions are to participate, better results will be obtained if one battalion acts as the defending force while the other attacks. If sufficient smoke munitions are available, the exercise should be repeated with the battalions changing places. In this manner, the units will obtain an excellent idea of the effect of smoke from both the attacker's and defender's viewpoint.

(2) A force is to attack a hostile position (occupied, outlined, or simulated) which has a good field of fire and little natural cover to protect the advancing troops. The advance will be protected by smoke. The rate of advance will be 100 yards in 2½ minutes.

(3) Prior to the time of the attack, a line of smoke pots wired for electric discharge, as described in paragraph 11*b* (4), will be placed 150 yards in front of the defender's line. The smoke pots should be about 20 yards apart. The battery or exploder should be placed where the operator is concealed from the attacking force and from the defender's position if the latter is occupied. The time required for the attacking force to move from the line of departure

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to a line about 300 yards from the hostile position will be estimated and at each firing point one smoke pot will be placed for each 6 minutes required for the advance.

(4) If an electric exploder, squibs, and wire are not available, the line of smoke pots can be discharged by a detail of men. The men should wear white hat bands, brassards, or other markings to distinguish them from the attacking troops. Upon signal from the officer or noncommissioned officer in charge, each man of the detail will fire one smoke pot and as it burns out, the second will be fired, and so on, depending upon the time during which the smoke screen is required. The effectiveness of the exercise will be increased if the men engaged in firing the smoke pots are concealed from view of the attacking troops. This can be accomplished by having a pit dug at each firing point, in which the man at that point is to stand or sit while firing the smoke pots.

(5) The officer or noncommissioned officer charged with placing the smoke screen must synchronize his watch with that of the commander of the attacking force. At the time specified for the attacking force to leave the line of departure, the smoke pots should be fired.

d. Remarks.—If the best results are to be obtained from this exercise, it should be carried out with suitable winds. Winds that carry the smoke toward the attacker are not favorable. In the event of flank winds (3:00 or 9:00 o'clock), best results can be obtained by placing the smoke pots near the upwind flank. If the advance is long and the supply of pots limited, the firing may be deferred until a portion of the distance has been covered. The screen should be started at least by the time the advance has reached a line 600 yards from the defender's position.

e. Points to be noted.—(1) Did umpires permit a more rapid rate of advance than would have been possible without smoke?

(2) To what extent did the advancing elements engage in fire action?

(3) How did the size of elements advancing at one time compare with those advancing in situations where no smoke was used?

(4) What methods of target designation were employed by officers and noncommissioned officers controlling the fire action?

(5) Was there any confusion as to the objective of each element?

(6) What influence did smoke have on the final assault?

16. Exercise No. 3—Influence of smoke on artillery fire.—*a. Object.*—The object of this exercise is to demonstrate the use of smoke in reducing the effectiveness of hostile artillery fire.

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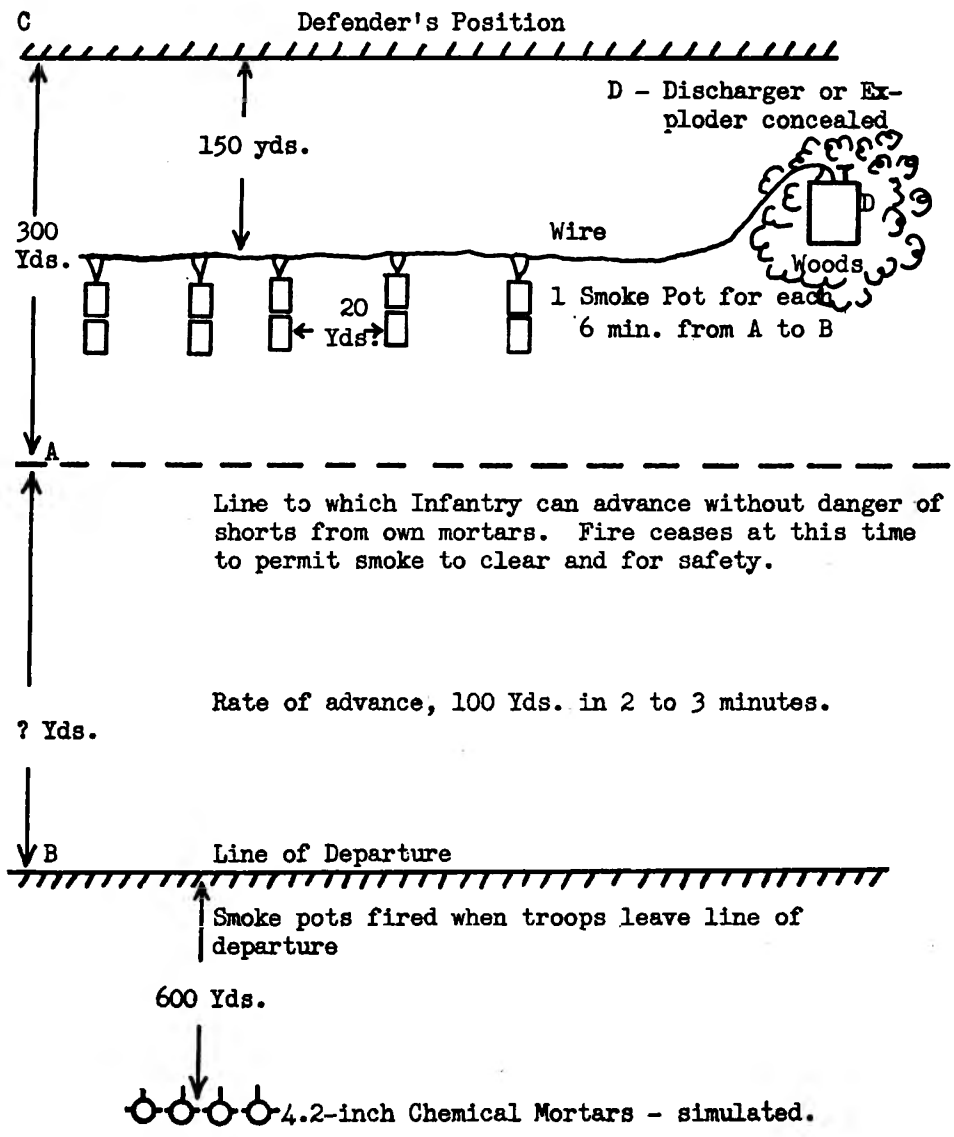

FIGURE 7.—Smoke to cover an infantry attack.

b. Discussion.—Observation of the sector for targets and fire for adjustment is highly important to the artillery in all supporting fire. A rule of smoke tactics is to deny the enemy this necessary observation without seriously hampering the actions of friendly troops. Training should provide for the action to be taken when an observation post is blinded by smoke.

c. Details.—(1) Prior to the time the battery or batteries organize their observation posts, a line of smoke pots wired for electrical discharge as described in paragraph 11*b*(4) will be placed about 100 yards upwind and 150 yards in front of the point where the OP will

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be established (fig. 8). The smoke pots should be at about 20-yard intervals and the battery or exploder should be placed where the operator is concealed from the observation detail. During the time the observation detail is conducting fire, the officer in charge will give the signal for firing the smoke pots.

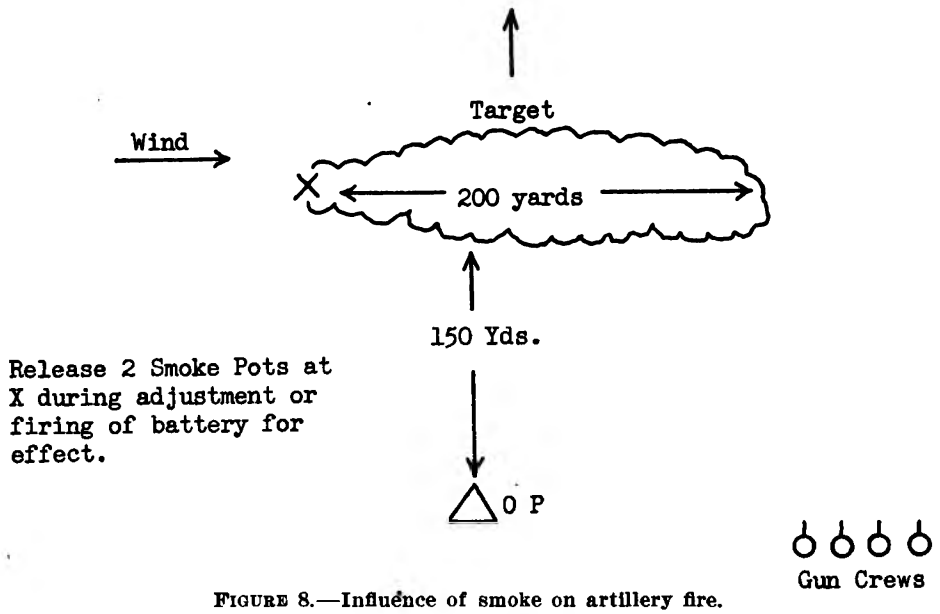

FIGURE 8.—Influence of smoke on artillery fire.

(2) If an electric exploder, squibs, and wire are not available, the line of smoke pots may be fired by a detail of men. Upon signal from the officer in charge, each man will ignite one smoke pot. The effect of this exercise will be somewhat lessened by having enlisted men in the open igniting smoke pots. This may be avoided by digging pits of sufficient depth to keep the men under cover.

(3) This exercise may be varied by igniting one or two tear gas grenades at such a position that the gas will drift over the observation detail. Harassing agents will be used in many cases at the same time smoke is used thus adding to the confusion and delay. If tear gas is used in this exercise, all men exposed should be equipped with masks. It is estimated that wearing the mask reduces the efficiency of instrument operators from 10 to 50 percent, depending upon their state of training.

d. Points to be noted.—(1) Was the effectiveness of the artillery fire reduced because of lack of observation?

(2) Did the smoke render the instruments useless?

(3) Was the rate of fire maintained?

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(4) If tear gas was used, what was the effect of wearing the mask on the comfort and efficiency of the personnel?

(5) What was the effect of wearing the mask on the transmission of firing data?

17. Exercise No. 4—Use of nonpersistent gas in preparation for attack. (For use by Infantry, Corps of Engineers, or dismounted Cavalry and medical detachments.)—*a. Object.*—The object of this exercise is to illustrate the offensive use of chemical agents by an attacking force immediately preceding an infantry attack and to teach the protective procedure to be adopted by troops before, during, and after a chemical attack upon them.

b. Discussion.—(1) The use of chemical agents by an attacker preceding an infantry attack is planned beforehand and carefully coordinated with the infantry plan of action. Usually there is wide opportunity for the successful employment of chemical agents before the infantry attack is launched. This is true particularly of nonpersistent gas. Persistent gas may also be used effectively in preparation for an attack, but the targets for such gas must be selected with care and the fire limited to areas which the attacking troops will avoid in their advance. This exercise illustrates fire of nonpersistent chemical agents on local reserves and strong points of a defender's position. The time of firing of such agents is planned so as to insure dissipation of the nonpersistent gas before the arrival of the attacking infantry at the targets fired on. Under average conditions of weather and terrain, 10 to 15 minutes will suffice for dissipation of such gas except in woods, dugouts, cellars, or other sheltered places. A sudden high concentration is usually fired on strong points or reserve troops during the night while men are asleep in order to catch them by surprise before they can adjust their masks; such a concentration may also be fired just prior to the infantry assault. The results to be expected from the use of a nonpersistent gas used in this manner are as follows:

(*a*) Casualties.

(*b*) Reduction of the efficiency of the defending troops by forcing them to mask, including reduction of their mobility, morale, and power of endurance.

(*c*) Harassing, by the imposition of a constant need for vigilance on the part of the defending troops.

(*d*) Effectiveness of the fire on troops in such places as trenches, dugouts, cellars, ravines, valleys, tunnels, caves, and woods which afford considerable protection against other kinds of shell fire.

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(*e*) Uncertainty of the defending troops as to the kind of agent used, resulting in perhaps useless and excessive precautions; or if they are reckless, numerous, and unwarranted casualties.

(2) The chemical agent usually employed will be phosgene, a nonpersistent agent. It is a lung irritant affecting the lower part of the lungs. The effect is cumulative and exposure to even low concentrations over an extended period will cause death. However, the gas mask protects completely against phosgene. Phosgene can be easily detected by its characteristic odor, which resembles musty hay or green corn. The most favorable conditions for projecting this type of attack are as follows:

(*a*) Between midnight and sunup, or just prior to an infantry assault.

(*b*) When there is no wind or when the wind velocity is between 3 and 12 miles per hour.

(*c*) When the wind direction is either toward the enemy or parallel to the front.

(*d*) When the target is in low ground or in woods.

(*e*) When the weather is foggy, overcast, or misty.

c. Details.—(1) Troops on the defense are either occupying a strong point or are held in reserve in an area protected from high explosive shell fire. They are equipped with gas masks. They are subjected to a surprise attack of tear gas representing phosgene projected either by artillery, chemical mortars, or Livens projectors.

(2) Prior to the occupation of position by the defending unit, a line of men spaced at about 30-yard intervals, each with two CN grenades, will be placed about 150 yards upwind from the defender's position (fig. 9). The impressiveness of this exercise will be somewhat lessened if the men to fire the grenades are in the open. This can be avoided by having the grenade detail occupy pits of sufficient depth to keep the men under cover. Upon signal from the officer or noncommissioned officer in charge, each man will ignite both grenades, throwing one 7 or 8 yards to his right and the other about the same distance to his left.

(3) Certain men of the unit subjected to the gas should be designated beforehand as gas casualties and immediately after the attack these men should be given first aid, sent to the rear, and there dealt with by medical personnel. Such casualties will be marked as "gassed, lung irritant" and will be handled and treated by the medical personnel accordingly.

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d. Points to be noted.—(1) Was a plan made or were orders given prior to the gas attack for the procedure to be followed in case of a chemical attack?

(2) Was a gas sentry posted?

(3) Was an alarm given?

(4) Did the men mask quickly?

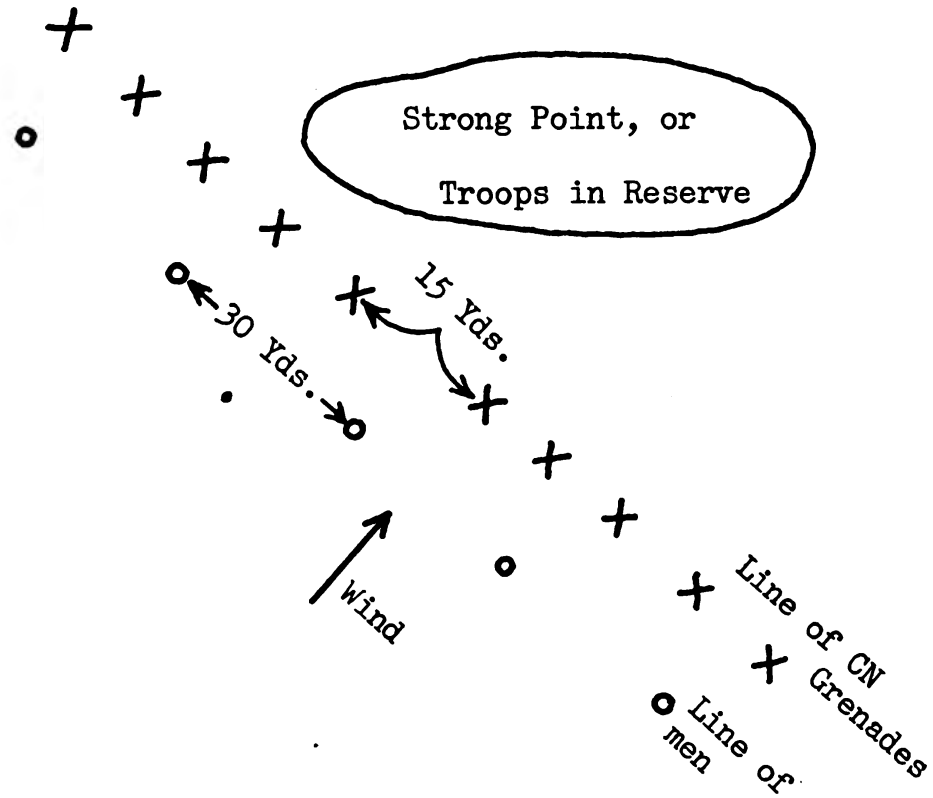

FIGURE 9.—Use of nonpersistent gas in preparation for attack.

(5) If gas-proof shelters were constructed prior to the attack, were these made gas proof?

(6) Were other units in support notified of the gas attack?

(7) Were casualties removed from the gassed area as soon as possible and first-aid treatment given?

(8) When were the gas masks removed? By whose authority?

(9) Were preparations made immediately to meet another attack?

(10) Was a report made to higher commander as to the size of the area involved, the unit involved in the chemical attack, and the type of chemical used by the enemy?

(11) What first aid was given to the gas casualties?

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18. Exercise No. 5—Employment of gas in counterbattery fire. (For use by field artillery and mobile coast artillery units.)—*a. Object.*—The object of this exercise is to teach the required protective procedure in case of the enemy's employment of persistent chemicals in counterbattery fire.

b. Discussion.—Persistent vesicants are effective counterbattery agents. Direct hits are not essential to place the battery in a toxic atmosphere. Where direct hits are obtained, every splash of the agent on the guns or ammunition is a source of danger. Masks, protective clothing, and gloves must be worn or the position evacuated. In case of evacuation, contaminated guns and equipment must be decontaminated.

c. Details.—(1) This exercise is a battery exercise. All batteries of a unit, however, may carry it out simultaneously, provided suitable terrain is available. The exercise should be conducted at a time when the battery is engaged in a firing problem. Arrangements must be made for the selection and occupation of an alternate position.

(2) A battery is engaging in a firing exercise. The firing position has been selected and occupied and fire opened. An alternate position has been selected. All personnel are equipped with gas masks and leather gloves to represent protective gloves.

(3) Prior to the occupation of position by the battery, a line of four to six men, spaced about 20 yards apart, each provided with two to four CN grenades, will be placed about 150 yards upwind from the position to be occupied by the battery (fig. 10). If possible, these men should be placed in pits or otherwise concealed from the view of the battery. Upon signal from the officer or noncommissioned officer in charge, each man will fire one grenade, throwing it a few yards downwind. As these grenades burn out, the officer or noncommissioned officer will give the signal for the firing of the second and succeeding grenades, the number fired at each point being determined by the action taken by the battery.

(4) About 1 minute after the tear gas has first been released or soon after it becomes effective, a messenger will hand the battery executive a message stating that the tear gas grenades represent mustard gas artillery shell. The executive will take the necessary steps for protection against persistent vesicant gas.

(5) Certain men of the unit should be designated beforehand as gas casualties and immediately after the attack, these men should be given first aid, sent to the rear, and there dealt with by medical personnel. Such casualties will be marked as "gassed, blistering

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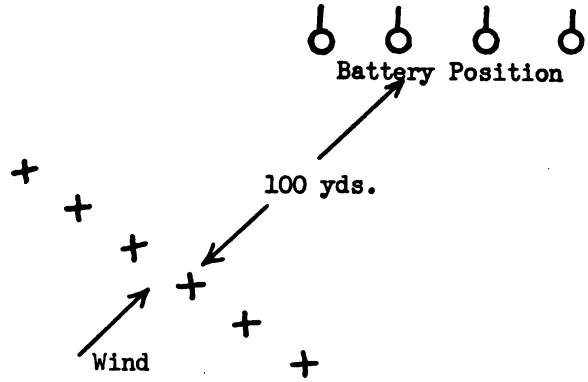
agent" with places marked on their uniform in chalk to show where they actually came in contact with liquid mustard gas. The medical personnel will give the proper treatment.



Four to six men (X) each with 2 to 4 CN grenades fire on signal, one grenade by each man at a time. Men should be concealed.

FIGURE 10.—Employment of gas in counterbattery fire.

d. Points to be noted.—(1) Were steps taken promptly for occupation of an alternate position?

(2) Was a gas sentry posted by the battery?

(3) If so, did the gas sentry give an alarm?

(4) What method of giving an alarm was used?

(5) Did the men mask quickly and correctly?

(6) What influence did masking have on control by commanders?

(7) What influence did masking have on the service of the guns?

(8) How did the time required for going out of action and evacuating the position compare with that required when no gas was present?

(9) What influence on general efficiency resulted from wearing protective gloves?

19. Exercise No. 6—Employment of gas in interdiction fire. (For use by any unit of the Army that moves by marching.)—*a. Object.*—The object of this exercise is to instruct troops in protection against chemicals used in interdiction fire on a road.

b. Discussion.—Persistent chemicals are extremely valuable for interdiction fire on roads. In attack, agents of moderate persistency such as CNS can be employed. This agent will force masking and hamper movement. In defense, the persistent vesicants such as HS may also be used. Agents of HS type not only force masking and hamper movement but will also cause casualties. Vegetation along a road on which such agents are used is likely to be contaminated and hence must be avoided, and men cannot sit down on or near the road

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without danger of being burned. Favorable points for interdiction fire with chemicals are points in woods, stream crossings, and other defiles where it will be difficult or impossible for troops to move off the road to avoid the gas without making an extensive detour.

c. Details.—(1) This exercise may be employed in training troops of any arm of the service that moves by marching. The exercise may be conducted during daylight; however, better results will be obtained if it is carried out at night. The size of the unit involved will be limited only by the number of gas masks available.

(2) A body of troops is to march along a road at a certain hour. These troops are equipped with gas masks.

(3) Ten to 15 minutes prior to the time the troops are to pass, a detail of six men, each man equipped with three CN grenades, will take position to place a CN cloud on the column. A point where the road passes through woods will be selected if available. The detail will be placed on the upwind side of the road at intervals of about 50 yards and from 25 to 50 yards from the road. Each member of the detail will conceal himself to the best advantage but will remain where he can observe the road. When the head of the column reaches a point where the tear gas from the nearest grenade will strike the column (fig. 11), the officer or noncommissioned officer in charge of the detail will give the signal for firing the first grenade at each position. As the first grenade burns out, the second and then the third grenades will be fired at each position.

d. Remarks.—There will be a period of from 30 seconds to 1 minute from the time the first grenade is fired until the cloud strikes the column. If the grenade is fired when the head of the column reaches the point where the cloud will strike the road, the column should have advanced 50 to 100 yards into the area that will be covered by the time the cloud reaches it. This should result in catching more than the head of the column when the alarm is given. The column will have a zone 300 to 400 yards through which it must march in gas. The number of grenades given herein should cover this section of road for a period of 6 to 8 minutes which should be sufficient.

e. Points to be noted.—(1) Was an alarm given?

(2) Did the men mask as soon as the gas struck them or the alarm was given?

(3) Was masking performed in the proper manner?

(4) Did men remove masks before told to do so by their officers?

(5) Was a test for gas made before the order for removing masks was given?

(6) How much confusion was caused by the gas?

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(7) To what extent was movement delayed?

(8) Did the attack result in any loss of control of organization commanders?

20. Exercise No. 7—Employment of gas in harassing fire. (For use in training troops that organize ground or send out working parties.)—*a. Object.*—The object of this exercise is to illustrate the use of chemicals by artillery in harassing troops either in bivouac or in position organizing a strong point.

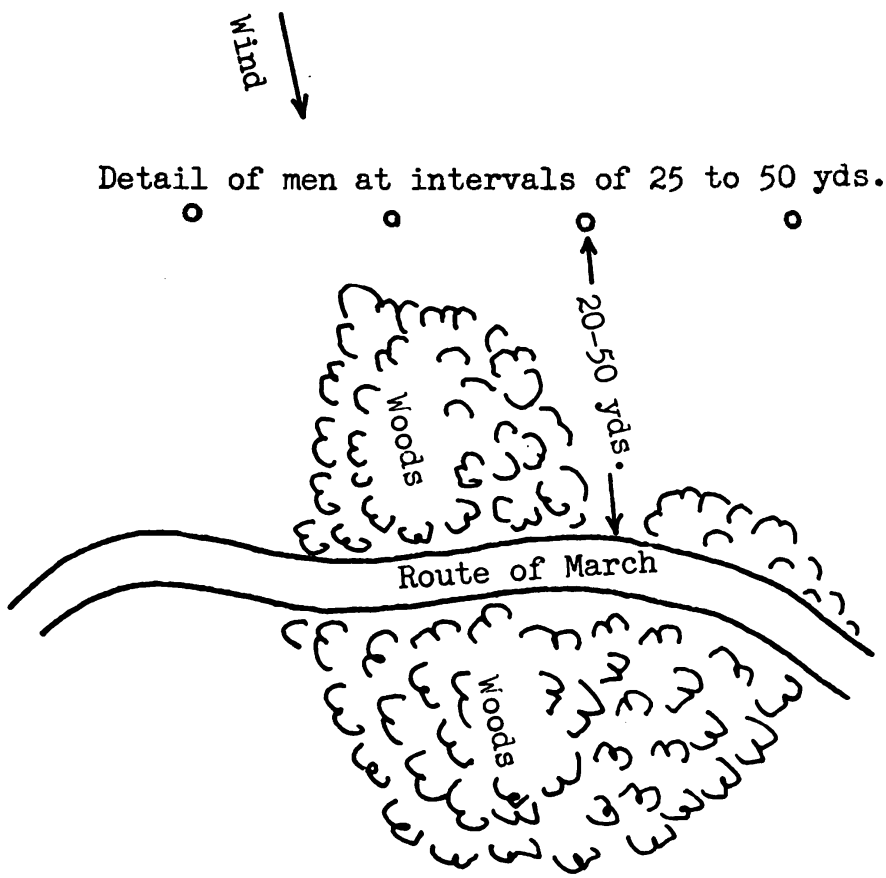

FIGURE 11.—Employment of gas in interdiction fire.

b. Discussion.—Inexperienced, undisciplined, or worn-out troops, or troops poorly equipped or poorly trained in protection against chemical attack offer the best target for gas. Harassing fire is particularly applicable against working parties and concentrations of troops to lower their morale and efficiency. Chemical agents have an advantage over other methods of harassing in that their persistency and effectiveness in low concentrations make it unnecessary to maintain continuous fire on an area to harass its occupants. In offensive operations, harassing agents of moderate persistency such as CNS

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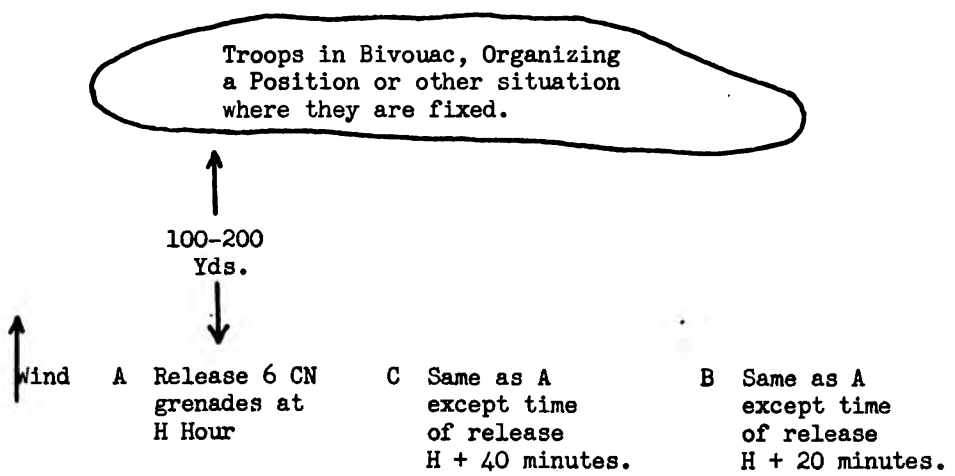
generally can be employed extensively. CNS will force masking and hamper movement. However, whenever a persistent agent is used in preparation for or in support of an attack, care must be taken to confine the gas to areas which the attacking troops will avoid or which they will not reach in their advance before the gas is dissipated. In defensive situations, persistent harassing agents such as CNS or low concentrations of a persistent vesicant such as HS are used. The latter will not only force masking and hamper movement but will also cause some casualties.

c. Details.—(1) This exercise can be employed in training any troops that organize ground or send out working parties. For best results, the exercise should be carried out during the hours of darkness, although a daylight exercise will suffice. The size of the unit involved will be limited only by the number of masks available for the exercise.

(2) A body of troops equipped with gas masks is either in bivouac, organizing a position, constructing field fortifications or wire entanglements, or in any other situation where the troops are fixed.

(3) Prior to the time the troops arrive, six grenades representing chemical mortar or artillery fire, are placed at each of the points marked A, B, and C in figure 12. At H hour, which should be about 5 minutes after the troops begin organizing their position, the six grenades at A will be fired. Grenades at points B and C will be fired at H+20 and H+40 minutes respectively. The time interval between the firing of grenades at each point may be varied from 15 to 30 minutes. The detail firing the grenades should be concealed



Time interval given as 20 minutes may vary from 15 to 30 minutes.

FIGURE 12.—Employment of gas in harassing fire.

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from the working troops. Shallow pits will provide the necessary cover in case natural cover is not available.

d. Points to be noted.—(1) Was a gas sentry posted over the working party?

(2) If so, did the gas sentry give an alarm?

(3) Method of giving the alarm.

(4) Did the men mask as soon as the gas struck them or when the alarm was given?

(5) Was masking performed in the proper manner?

(6) Did the men remove masks before told to do so by their officers?

(7) Was a test for gas made before the order for unmasking was given?

(8) How much confusion and noise among the men was caused by the gas?

(9) To what extent was working delayed?

Section III

GAS CHAMBER

Paragraph
Gas chamber 21

21. Gas chamber.—*a.* The gas chamber is a building, room, or possibly a tent, used for testing the fit and condition of the mask and in the training of the individual. While lack of cracks and openings through which gas may escape is an advantage, the enclosure need not be airtight. A gas chamber of sufficient size to accommodate 12 to 16 men is generally desirable. However, gas chambers accommodating units from the size of a squad up to a company have been used. The gas chamber should be so situated that escaping gas will not inconvenience persons in adjacent areas. At the same time it should not be so far from troop areas that time and transportation become problems.

b. Troops to be trained are divided into groups of a size suitable to the chamber. An instructor controls the groups outside the chamber. A second instructor controls the group in the chamber. Before the first group enters the chamber, a concentration of tear gas is built up with CN capsules. The usual method is to place two capsules on the bottom of an empty tomato can superimposed over a lighted candle. This concentration is maintained by adding more capsules from time to time as necessary.

c. To determine the condition or fit of the mask, members of a group adjust masks, are inspected by the outside instructor, and

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then enter the chamber. After remaining for a few minutes, at the direction of the instructor in the chamber, they pass to the outside when they are again inspected before removing masks. Any individual showing signs of lacrimation must be rechecked for fit of his mask and the mask is examined for defects. Men who have been in the chamber are kept down wind from those remaining to be checked in order that CN in the clothing of the former will not affect the remaining groups.

d. To prove to the individual that his mask provides protection, a second exercise is conducted. This exercise is carried out in the same manner as the first exercise with the following exception: Prior to leaving the gas chamber, members of the group are directed to remove their masks. They then pass from the chamber.. The effect of the lacrimator, when masks are removed, demonstrates clearly that the mask has provided protection. Individuals whose masks have been found defective or who are found improperly fitted in the first exercise, should not participate in the second exercise until properly fitting serviceable masks have been provided them and tested.

[A. G. 062.11 (2–8–40).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

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